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Textural Characteristic of Margarine Enriched with Pectin Fiber by Using Blending Method

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***Abstract*—Margarine is one of water in oil emulsion type, made from palm oil and its functional properties could be improved by addition of pectin as a food fiber. texture is an important characteristics in margarine and addition of pectin in margarine might change the textural characteristics. The purpose of this research was to study the influence of addition of pectin in margarine an its texture. The research method used was experimental followed by regression analysis and correlation. The experiment consisted of five treatments with three replications. Those are the addition of pectin in margarine in five levels 0%, 2%, 4%, 6%, and 8%. The addition of pectin gave negative correlation to the hardness, cohesiveness, elasticity modulus, and toughness modulus characteristic; but gave positive correlation to adhesiveness and relaxation time characteristic.**

***Keywords*— Margarine, pectin, texture, viscoelastic.**

I. INTRODUCTION

Information about final paper submission is available from the conference website. Margarine is one food that has long been developed in Indonesia until 2011 it is approximately 17 companies engaged in this industry. According to the survey of PT.CIC (2011), there are 17 industrial margarine firms with total production capacity 357 900 tonnes per year in Indonesia. The location of margarine firm spread in Jakarta, West Java, East Java, Central Java, North Sumatra and West Sumatra. Margarine is necessary for many industries of bakery, biscuit and snack, chocolate, catering services, restaurants, domestic, and the other of food industry. Increased consumption of margarine in each year continues to encourage the margarine industry as manufacturers to improve quality in accordance with the needs of today's society. Public awareness in the importance of healthy living with the basic appearance of the addition of fiber in various food products. On the other hand, the current changes in diet leads to a dish which has a lot of fat but low in dietary fiber (dietary fiber), it has an impact on the development of degenerative diseases (heart disease, various cancers, and other diseases such as obesity, hyperlipidemia, atherosclerosis, gallstones, diverticulosis disease, hemorrhoids, hernia and colon cancer (Pamela, 2011).

Dietary fiber has been known to have an important role in lowering plasma cholesterol levels (Astawan, 2004). The results Potter and Hotchkiss, (1993) in Astawan, Wresdiyati and Koswara, (2004) concluded that the addition of some kind of fiber in the human diet can reduce levels of LDL (Low Density Lipoprotein), which is 65% component of LDL cholesterol has potentially causing disease coronary heart disease. Dietary Guidelines for Americans recommends for consuming the foods that contain starch and fiber in the correct amount (20-35 g/day). The result of Bogor Nutrition Research shows that the average fiber intake of Indonesia's population is about 10-15 g/day . The number of consumption this course is still very far from the recommended intake adequacy (Anonima, 2007).

Margarine is one of product type derived vegetable oil. For making the food such as healthy food, then it needs to be added to the source of dietary fiber which has the characteristics that will not change the quality of margarine too far. The addition of fiber in the manufacture of margarine has never been done by margarine industries, during the addition of materials that contain fiber such as pectin and gum to be as a stabilizer. The main texture of margarine characteristics is soft which making it easy to spread. Addition of pectin and gum as a stabilizer in the manufacture of argarine is only 0.5% even none at all because more manufacturers use chemical stabilizers can also help maintain other physical characteristics. The addition of pectin to the amount that exceeds the use of pectin as a natural stabilizer in general will affect the texture of margarine produced. In this study, the effect of pectin addition on the texture of margarine.

II. METHOD

Experiments was carried out in September-November 2012 at the Laboratory of Food Processing Engineering, Laboratory Testing Services, Department of Food Industrial Technology, Faculty of Industrial technology Agriculture, Universitas Padjadjaran, Jatinangor.

The raw materials used were the oil palm stearin fractionation of palm oil (RBDPS), beta carotene and butter flavor, palm olein oil (RBDPE), commercial citrus pectin, salt, and water. The tools used in the experiment were *Texture* Analyzer TX 32, homogenizer, and other supporting tools.

The method used was the Experimental research the followed by regression and correlation analysis. This method used five types of treatments with three replications. The treatment to be observed in this study are:

A. Margarine without added pectin
B. Margarine with the addition of pectin as much as 2% of oil mixture
C. Margarine with the addition of pectin as much as 4% of oil mixture
D. Margarine with the addition of pectin as much as 6% of oil mixture
E. Margarine with the addition of pectin as much as 8% of oil mixture

TABLE I
MARGARINE FORMULATIONS WITH VARIOUS TREATMENT

Row Material	Composision (g)				
	A	B	C	D	E
Oil Mixture (g)	100	100	100	100	100
Pectin (g)	0	2	4	6	8
Water (g)	20	20	20	20	20
Salt (g)	4	4	4	4	4
Lecithin (g)	0.2	0,2	0.2	0.2	0.2
Flavor (g)	0.002	0,002	0.002	0.002	0.002
β-carotene (g)	0.001	0,0013	0.001	0.001	0.001

Source : Modification of Dewi, 2011; Harlinawati, 2002;and Ramayana, 2003.

a) Mixing of the oil phase; b) Mixing of the water (modification by Dewi, 2011; Harlinawati, 2002) Observations was done an :

1. Textural margarine characteristic by TPA (Texture Profile analyzer)
a. Hardness (Bourne, 2002)
b. Adhesiveness (Bourne, 2002)
c. Cohesiveness (Bourne, 2002)
2. Viscoelastic characteristics of margarine.
a. Modulus of Elasticity (Bourne, 2002)
b. Modulus of Toughness (Bourne, 2002)
c. Relaxation time (Bourne, 2002)

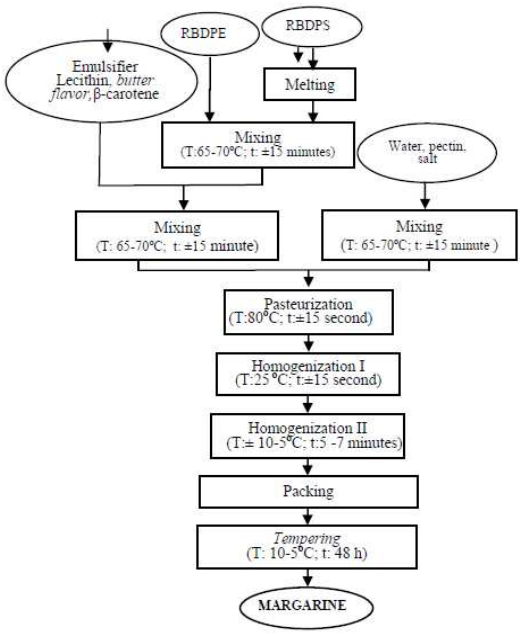

Fig 1. Flowchart of margarine enriched pectin fiber processing

III. RESULT AND DISCUSSION

A. *Text Font of Entire Documen Texture Profile Analysis (TPA*)

Measurement parameters of TPA for margarine texture are consisting of hardness, adhesiveness, and cohesiveness. TPA Curve of margarine with treatment 2% pectin addition can be seen in the Figure 2.

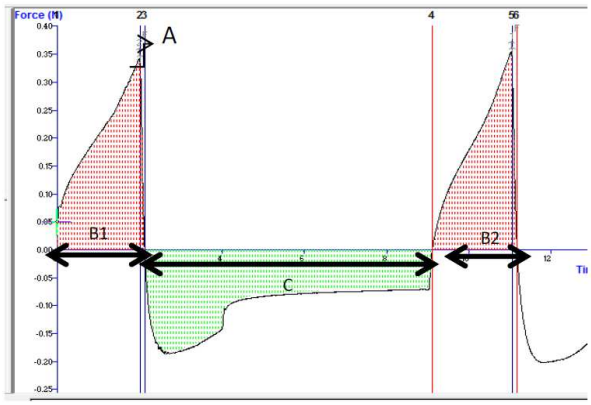

Figure 2. TPA Curve of Margarine Enriched Food Fiber Pectin 2%
Notes : A) Hardness; B) Cohesiveness; C) Adhesiveness

The result of texture test can be seen in the following table:

TABLE II
THE RESULT OF TEXTURE TEST

Pectin addition	Hardness (N)	Cohesiveness	Adhesiveness (g/s)
0%	0.111744	0.838	-66.757
2%	0.100154	0.852	-75.947
4%	0.100894	0.845	-87.683
6%	0.091534	0.800	-84.035
8%	0.083554	0.790	-101.182

1) The Effect of Addition of Fiber Food Pectin on the Margarine Hardness

Hardness is the main parameter in determining the texture of spreadable fat (margarine and butter) and a big influence on consumer acceptance (Bourne, 2002). Value of hardness in margarine will demonstrate the ease of pressing margarine is also related to the smeared simplicity expressed in newtons or kg.m/s2. Based on regression analysis and correlation TPA hardness of margarine is known that the addition of pectin showed significant impact on the change in hardness of margarine on the addition of pectin treatment. The relationship between the hardness of the addition of pectin used close to the following equation: Y = -0.0033 x + 0.1106

Negative slope value of the equation shows that the hardness values decreased with the increasing of pectin addition. Pectin is one of the forms of hydrocolloid, which is a water-soluble polymer, able to form colloidal solutions and o coagulate by forming a gel from the solution. The gel is principally formed due to cross linking polymers consisting of long chain molecules in sufficient quantities. The cross linked polymer will form a continuous three-dimensional structure which solvent molecules will be trapped inside, it immobilized and form a structure that resists to force or pressure of solvent. Pectin solution can absorb as much as possible until it reaches the maximum size (Brejnholt, 2010), the more water absorb the softer gel molecules are formed. Thus the addition of pectin might form the margarine texture becoming softer.

2) The Effect of Addition of Fiber Food Pectin on the Margarine Cohesiveness

Based on regression analysis and correlation TPA of cohesiveness margarine is known that the addition of pectin gave a significant effect on the value of cohesiveness. The result showed that the greater the addition of pectin the lower margarine cohesiveness. The relationship between treatment cohesiveness with the addition of pectin used is best suited with the following equation: Y = -0.0035 + 0.85 x Cohesiveness value in this study believed that the effect of adding more pectin will absorb the amount of water so that when margarine produced will be more rigid and when pressed texture will form cracks while the slight increase in pectin or not at all will result in margarine with a smooth texture when done pressurized. Margarine texture was hoped to function as a smear, softness governed by water content in them (Rosenthal, 1999). Distribution of pectin which absorbs water in margarine affect the ease change of shape becomes less soft and looks like a crack.

3) The Effect of Addition of Fiber Food Pectin on the Nature Margarine Adhesiveness

Adhesiveness or stickiness is defined as the work to overcome the attractive forces between food materials surface with other materials (Bourne, 2002). Based on regression analysis and correlation TPA of adhesiveness margarine seen not affected by pectin addition TPA test is a test that mimics the movement such as biting then the adhesion strength tackiness margarine like teeth and palate in the mouth at the time.

B. Fundamental Textural of Food Fiber Pectin Enriched Margarine

Fundamental method of testing performed on the dietary fiber pectin-enriched margarine produces three kinds of output; force, time and distance. Then, the three kinds of data are transformed into three parameters: modulus of elasticity, modulus of toughness and relaxation time.

The test results of the three parameters can explain the rigidity and flow properties of the resulting margarine.

1) The Effect of Food Fiber Addition in the Modulus of Elasticity

Modulus of elasticity is the ratio of stress strain when an elastic solid material is compressed or extended. Modulus of elasticity value describes the size of the stiffness of material. Modulus of elasticity is also equal to the slope of the curve between stress and strain (Bourne, 2002). Calculating the modulus of elasticity value is done by transforming the initial data into stress and strain values. The elevation elastic of modulus and pectin addition then was analyzed by regression and correlation analyzed. Then the data was fitted in to theirlinier curve. Which the modulus elasticity is as determined between the slope of the curve. The result stated that the addition of pectin showed significant impact on changes in the elastic modulus margarine. Elasticity modulus curve margarine with the addition of pectin can be seen in Figure 3.

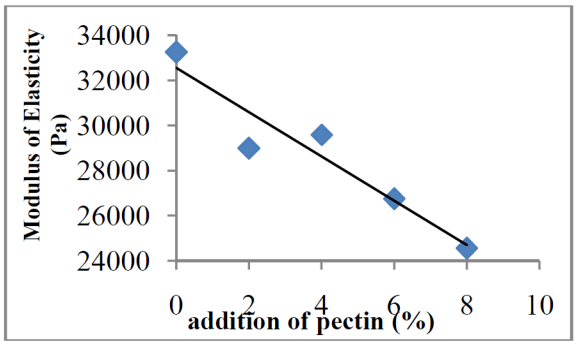

Fig. 3. Curves of Relationship between addition of food fiber pectin with Modulus of Elasticity Value

Based on Figure 3, it appears that the effect of the addition of pectin in each treatment is suitable for linear regression models because the R2 value obtained was 0,906 and has a value of r (correlation coefficient) is close to 1. The relationship between the modulus of elasticity and the addition of pectin used best suited to the following equation: X + Y = -980.25 32547. Testing of stiffness margarine enriched with pectin showed that the more the addition of pectin will decrease stiffness. Stiffness of the material is a material's ability to withstand the stress of the outside material until there is a change of form, expressed in units of Pascal.

Modulus of elasticity can also be expressed as quantitative material, the value of lower modulus of elasticity is same as the lower elasticity of material.

Margarine without added pectin had the highest elasticity value, at which time the material is pressurized then the material will be easier to return to previous forms, while the more addition of pectin to the more difficult the

material back to its original shape. Testing modulus of elasticity has a relationship with imitative result test on the characteristics of cohesiveness which both show the same result. Cohesion or attraction between molecules is low causing the lower elasticity of the material, because the lower of attraction between molecules of the material is more difficult the material back to its original shape or not elastic. The more addition of pectin will lead decreased and cohesion in margarine produced.

2) The Effect of Food Fiber Pectin Addition in the Modulus of Toughness

Modulus of toughness is the area of the stress strain curve, has a value which is identical with total energy of compression. Total energy is the compression force area curve ratio force with distance (distance movement of the probe). Both of them illustrate the value of resistance of materials quantitatively. Modulus of toughness calculation is done by transforming the initial data into stress and strain values then the value of the data plotted to a stress-strain curve is then calculated curve for the area to determine the modulus of toughness. The relation Modulus of toughness and pectin addition was then analyzed by correlation and regression analysis. Based on Figure 4, it appears that the effect of the addition of pectin in each treatment is suitable for linear regression models because the R2 value obtained has a value of 0.94 and r (correlation coefficient) is close to 1. The relationship between the modulus of toughness with the addition of pectin used close to the following equation: Y = - X + 2118.637 60.103.

The equation is an equation in parameter estimation modulus of toughness margarine toward addition of pectin treatment.

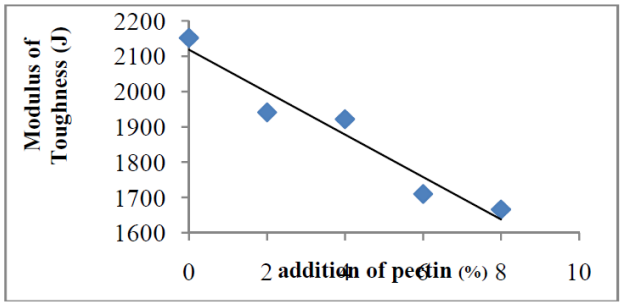

Fig 4. Curves of Relationship Between Addition of Food Fiber Pectin with Modulus of Toughness Value

Modulus of toughness is the amount of energy absorbed by the material until the material deformation (flow), which is expressed in Joules (J). Absorbed energy is used to deform, follow the direction of loading is experienced (Bourne, 2002). Testing modulus of toughness value in margarine also shows decreasing trend as the increasing of pectin addition. Characteristic of gelling pectin greatly affect the properties of the resulting texture and cause the resulting margarine was more dominated by the properties of pectin gels. The types of gels produced from hydrocolloid materials consisted three kinds of soft gel, elastic gel-to-hard, and bittle gels, whereas pectin is a kind of soft gel (Brejnholt, 2010); thus the more addition soft gel will decrease toughness.

3) The Effect of Food Fiber Pectin Addition in the Relaxation time Margarine

Relaxation time is the time needs for a substance to reduce its stress value by 37% after reaching a aximum tension for example in the form of pressure on the material. Emphasis on testing performed by the probe as deep as 10 mm probe detention then hold for 10 seconds, and at the time of the stress that initially material reaches high tension will decrease or be called relaxation.

Tension during the relaxation time will decrease until it reaches a stable value of tension. According to Wiess (2008), the longer the relaxation time of a terial then the material has properties closer to solid. Results of the analysis stated that the addition of pectin howed significant impact on changes in the relaxation time margarine. Curves of relationship between relaxation time with the addition of pectin can be seen in Figure 5.

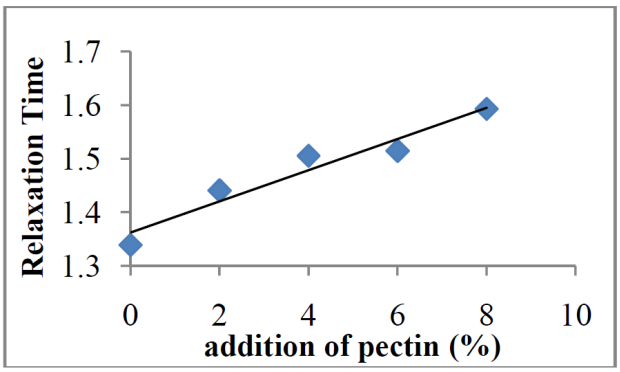

Figure 5. Curves of Relationship between addition of food fiber pectin with Relaxation Time

Based on Figure 5, it appears that the effect of the addition of pectin in each treatment is suitable for linear regression models because the R2 value obtained has a value of 0.94 and r (correlation coefficient) is close to 1. The relationship between the relaxation time of the addition of pectin used close to the following equation: Y = 0.0291 x + 1.362. Based on the equation, it can be stated that the longer the margarine relaxation time increases as the increase ofpectin addition. Addition of pectin forms a gel with viscoelastic properties and margarine should be more solid because of the increasing number of solid ingredients in margarine is marked by the longer relaxation time on treatment Pectin addition in margarine.

IV. Conclusion And Recommendation

A. Conclusion

The addition of dietary fiber pectin showed significant impact on the characteristics of texture. Characteristic of relaxation time on the adhesiveness and margarine have increased along with the addition of dietary fiber pectin. Characteristics of hardness, cohesiveness, the total energy of compression, modulus of elasticity, modulus of toughness the margarine.

B. Recommendation

Need to be studied about types of fiber and other types of oils that can be used in the manufacture of margarine to produce margarine which is good for health.

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